SYNOPSIS OF THE PH.D. THESIS

(In the Subject of Botany)

Title

"Studies on post-harvest Rhizome Rot Disease of Turmeric Caused by *Fusarium solani* in Marathwada Region"

Submitted to

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Under the Faculty of Science & Technology

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INTRODUCTION:

Since the beginning of time, turmeric (*Curcuma longa L.*), also called as "haridra" or "yellow colored wood" in Sanskrit, has been used in Indian cuisine, medicine, and ceremonies. This spice's anti-oxidant properties shield organic cells from the high energy free radical damage. This herb's antibacterial, antiviral, antifungal, and anti-inflammatory characteristics seem to be an efficient treatment for a number of illnesses. Additionally, it is said to cleanse the liver, control cholesterol levels, treat allergies, promote healthy digestion, strengthen the immune system, and improve skin. It is one of the significant spice crops that contribute significantly to India's national economy. Turmeric is mostly produced and exported by India.

The usage of the turmeric plant for medical purposes dates back over 4000 years. Turmeric is utilized in Southeast Asia both as a primary spice and as a part of religious rituals. Turmeric, which is a vivid yellow color, is also referred to as "Indian saffron" because of this. The more than 3000 publications on turmeric that have been published in the last 25 years show that modern medicine has started to understand its significance. The safety and effectiveness of turmeric are further discussed after discussing in vitro research, animal studies, and ultimately studies conducted on humans. Crop rotation is one of the most effective disease management strategies for this issue. However, the susceptibility of the rotating crop to this pathogen could result in crop failure. Therefore, knowledge of the pathogen's host range over rotational crops will be useful for better disease control. Bangladesh, Germany, Iran, Japan, Malaysia, South Africa, Singapore, Sri Lanka, the United Arab Emirates, and the United States are the top importers of turmeric (http1). More than 200 districts across 25 states in South and North Eastern India are where it is grown. More than 75% of the country's total production of turmeric is produced in Andhra Pradesh, Assam, Kerala, Maharashtra, Orissa, and Tamil Nadu. Numerous fungal infections, both airborne and soil-borne, can affect turmeric. Viral and bacterial illnesses are uncommon. Rhizome rot, leaf spot, leaf blotch, leaf blast, and leaf blight are the major diseases harming the crop, other issues include nematode infestations and storage rots. Rhizome rot is the most damaging disease, inflicting significant economic harm.

The most devastating disease affecting turmeric plants in India is rhizome rot, which lowers the crop's economic and commercial worth. Rhizome rot is brought on by *Pythium aphanidermatum*. An intriguing strategy for improving innate disease resistance is the potential

for increasing internal plant defenses. When higher plants become infected by phytopathogens or after being exposed to biotic and abiotic elicitors, they are able to start a variety of defense mechanisms.

In some areas of the Marathwada region where turmeric is grown, the crop is a Zingiberaceae member like *Curcuma longa* and is susceptible to diseases like rhizome rot. A perennial herbaceous monocotyledon spice, turmeric is also a significant source of foreign exchange. The two main forms of turmeric export are dry and powder. Rhizome rot is a continuous danger to the cultivation and storage of turmeric even though it is a crop with a high rate of return. Due to this disease, storage losses of between 50 and 80 percent have been documented. Turmeric was once widely grown in the area, but many farmers stopped doing so as a result of the recurrent rhizome rot disease that ruined their harvests. Rhizome rot, which is brought on by *Pythium spp*., is reportedly a disease that affects crops like *Zingiber officinale*. The role of these crops in the pathogen's survival may be the root of the turmeric rhizome rot illness in the upcoming growing season. In order to learn more, the current investigation was started.

REVIEW OF LITERATURE:

Turmeric *(Curcuma longa L.)* is a valuable medicinal plant as well as spice crop in Bangladesh. The rhizome rot disease is a severe danger to turmeric cultivation. The current study sought to identify the fungal pathogen linked to turmeric rhizome rot disease. Rhizome of turmeric with distinct rotted symptoms was collected from the experimental site of the Botanical Garden, Jahangirnagar University, Bangladesh. The sample was screened to isolate the causative fungal pathogen through the tissue planting technique. (Md. Sabbir Ahmmed, Fatema Akter Nisha, Nuhu Alam, 2022).

Turmeric (*Curcuma longa L*.), known as ‘haridra’ meaning yellow colored wood in Sanskrit, is a part of Indian delicacies, health care as well as rites and rituals since time immemorial. The anti-oxidant attributes of this spice protect against the high energy free radical damage to organic cells (Maheshwari, 2006).

The antibacterial, antiviral, antifungal and anti-inflammatory properties of this herb appear as an effective cure for several diseases (Nagi et al.1999, Kim et al.2009, Chan et al. 2010, Koosirirat et al. 2010).

Treated turmeric plants showed increased resistance towards rhizome rot disease caused by *Pythium aphanidermatum*, whereas control plants expressed severe rhizome rot disease. Increased activity of defense enzymes in leaves of chitosan treated turmeric plants may play a role in restricting the development of disease symptoms. The eliciting properties of chitosan make chitosan a potential antifungal agent for the control of rhizome rot disease of turmeric. (Sathiyanarayanan Anusuya and Muthukrishnan Sathiyabama, 2014).

Pythium aphanidermatum (Edson) Fitzp. belonging to Oomycetes is a well known devastating pathogen of many vegetables, fruits, grasses and ornamental crops in several parts of the world with a wide host range. It is also known to cause rhizome rot disease in turmeric. Disease management approaches like intercropping may not become a failure against pathogens with wide host range. (K. Anoop and R. Suseela Bhai, 2013).

Fungicide application programme may influence the development of resistance in the pathogen. Therefore, effect of successive passages of *Fusarium solani* on benomyl individually, alternately or in mixture with other fungicides having different mode of action was studied both in vitro and in vivo. Resistance in the pathogen may increase or decrease its virulence. Resistant strains of the pathogen are metabolically more active than the sensitive strains (Gangawane and Reddy, 1987).

The disease soft rot of turmeric caused by *Pythium myriotylum Dreschl.* This is an important disease prevalent in all turmeric growing areas. (Rathaiah, 1982).

Pathogenicity testing was done according to Koch s postulates. Hence, this is the comprehensive report on identify of major fungal pathogens associated with rhizome rot.(V.Sarathi, Senthil kumar, R.Senthil kumar and A.Panneerselva, 2014).

Isolated Fusarium equiseti, *Fusarium oxysporum* and *Fusarium solani* from the necrotic root tissue of diseased guayule. They observed that *Fusarium solani* as the most prevalent among them. They proved the pathogenicity test and found that *Fusarium oxysporum* as the most virulent, causing 60-70% root rot symptoms of the inoculated roots (Ykema and Stutz, (1991).

Rhizoctonia and Fusarium are the other organisms found frequently associated with the infected samples. Out of 118 samples, 74.5% yielded *Pythium spp*., 30.51% yielded Fusarium and 28.8% yielded Rhizoctonia spp. Some samples yielded a combination of these three organisms.

The pathogenicity studies of these isolates may prove the role of these organisms for the exact cause of rhizome rot disease in turmeric. (Anoop, K., Suseela Bhai, R. and Shiva, K.N. 2014).

Future studies on crop loss assessment due to these diseases, their epidemiology under different cropping systems and the role of biocontrol agents and organic amendments in disease suppression need a thorough investigation to develop appropriate disease management strategies. The present status of turmeric diseases and future strategies for their management are outlined in this paper. (T G Nageshwar Rao,1995).

Isolation:

Mukadam et. al., (2006) illustrated several pathogenic fungi. They isolated and studied the characters of Macrophomina phaseolina.

Pathogenicity test:

Observed the two new leaf spot diseases of Betelvine from India. They studied pathogenicity of isolated pathogen *Alternaria alternata* and *Curvularia lunata* from leaves of piper betel and confirmed their pathogenicity (Ojha, et.al,1988).

Biological control:

Hesamedin Ramezani, (2008) evaluated the efficacy of four fungal bioagents viz., *Trichoderma hamatum, Trichoderma harzianum, Trichoderma polysporum* and *Trichoderma viride* in vitro condition against the Egg plant root rot caused by *Macrophomina phaseolina* pathogen. He obtained pathogen and bioagents used in the present study from the Division of Mycology and Plant pathology, IARI, New Delhi, India. He used one week old culture of pathogen and bioagents maintained on PDA slants at 28±2°C for the present study. He determined the antagonistic activity of these bioagents by Dual Culture Technique and recorded percent growth of antagonists, pathogen and zone of inhibition as after 8 days of incubation. Among the bioagents, *T. harzianum* produced the maximum inhibition zone of 18.20 percent as compared to the minimum of 7.30 percent by *T. hamatum*. Soil application of talc - based formulation of *T.harzianum, T. polysporum* and *T. viride* effectively controlled the root- rot of Egg-plant under field condition.

OBJECTIVES:

1) To isolate & identify fungi associated with rhizome rot.
2) To study the Pathogenicity test of *Fusarium solani*.
3) To study the biochemical changes during infection.
4) To study the health of rhizome effected by fungi.
5) To study biological control of seeds borne pathogens.

SIGNIFICANCE OF THE STUDY:

1. Isolation & Identification of fungus.
2. Sustainable production of rhizome.
3. Reduce the yield losses.
4. Improve the quality and security of storage rhizome.
5. Management of seed borne fungi of rhizome.

RESEARCH METHODOLOGY:

1) **Collection & Isolation of pathogen:**

   Infected rhizome with characteristics symptoms was collected in sterilized polythene bag from the field of Marathwada. The diseased sample was washed with distilled water, followed by surface sterilization with 5% NaOCl for 3 min.

   The diseased sample was cut in to pieces & inoculated into PDA medium at room temperature (25^0C) to isolated fungal pathogen.

2) **Identification of pathogen:**

   The isolated fungal pathogen was identified through morphological and molecular techniques. Morphological identification was carried out by observing characters of the colony, mycelium and conidia and pigmentation of the conidia.

3) **Pathogenicity test:**

   Healthy rhizome of turmeric cleaned with distilled water. The artificial wound was made by needle and inoculated 2mm diameter of tested fugal pathogen. These are kept 25^0C in desiccator with Moistened cotton to preserve humidity. After 30 days of inoculation a typical symptoms was reproduced and pathogen was reisolated.

4) **Biochemical Changes during infection**

5) **Growth responses of the fungus to culture media, temperature & pH:**

Culture media, temperature & pH play important role in fungal growth and development.

6) **Statistical analysis:**

The statistical analysis of the obtained data will be carried out by using the standard methods given by Panse, Sukhatme (1967), Mungikar (1997).

7) **Biological control**

TENTATIVE CHAPTER'S SCHEME:

1. Introduction
2. Review of literature
3. Research Methodology
4. Result and Discussion
5. Conclusion
6. References

PROPOSED WORK PLAN/ STRUCTURE OF THE STUDY:

The following plan of study has been proposed to accomplish the aim and objectives of the present study.

First year plan of work:

1) Study the course work for research awareness and to enhanced the self-growth with respect to concept and knowledge of the subject.
2) Extensive review of literature related to the topic.
3) Collection of infected plant part from different location of different varieties.
4) Isolation, purification and pathogenicity of pathogen and diseases.

Second year plan of work:

1) Effect of physical factors on diseases development.
2) Biochemical changes during infection.
3) Reference collection would be done as required extent.

Third year plan of work:

1) Chemical and Biological Control.
2) Statistical analysis
3) Thesis writing.

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Research Student **Research Guide**

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